Taxonomy, Anatomy & Embryology

Unit–I

Q. 1. ***Explain the Phyletic or Phylogenic relationship.***

Ans. Phylogenetic relationship aims at relationship amongst individuals through their ancestory. The concept has variously been attributed by different taxonomists. Henning (1966) says it is in fact cladistic relationship. Simpson (1961) is of the opinion that cladistic, phenetic and chronistic relationships are all similar to each other. Where else Davis and Heywood (1963) are of the view that cladistic and phyletic relationships differ in their approach. So far as numerical methods are concerned it has been used in a more generalized manner.

When all these kinds of resemblances are visualised it appears that phenetic aspects in plants may lead to a polyphyletic taxa and conventional monophyletic ones, because often the existing relationship may be due to convergent evolution. Therefore, though phenetically plants may be similar yet they may have different phylogenetic history, why it should be felt at all that only on account of different phyletic (phylogenetic) history phenetically similar taxa may be kept apart. Taxonomists have diversity of opinion regarding this. However, phyletic approach to the classification may place apart phenetically close forms due to their origin from different ancestory. it, therefore, becomes clear that classifications designed in a particular way taking any specialized aspect may serve only the specific purposes in taxonomy. These procedures from different angles have well been discussed by Henning (1966). At the same time while dealing with cladistic approaches one has to face serious problems in construction of an exact pathway which an individual has followed during its evolutionary course. This fact has been unfolded through the fossil record which is incomplete and fragmentary. The traditional usage of embryological evidences on phlogeny with convention that "Ontogeny repeats phylogeny" is now

Scanned by CamScanner

contradicted, hence recent literature reveals that developmental stages do not necessarily repeat the phylogenetic history (Henning, 1966) and such evidences, therefore, may lead to serious descrepancies in the inferences while attempting the classification. Yet one has to agree that ontogeny has its own place as an aid to systematics.

Now, if these aspects do not sufficiently provide data for cladistic classification it is yet to be seen if it is possible to derive evidences favouring 'phenetic' approaches for cladistic classification. Under the circumstances problem of arriving at polyphyletic base can not be ruled out, where else the phylogenetic classification are no doubt constructed on broad based ideas of monophyletic origin.

Q. 2. *Explain the Natural System of classification.*

Ans. Linnaeus' system was the last among the artifical systems of classification although it did provide a "fragment of natural system". The systems that followed were based on natural affinities. Bernard and Antoine Laurent de Jussieu and Augustin Pyramus de Candolle made significant contribution in this direction.

Antoine Laurent de Jussieu (1686-1758), a French botanist, published his system in final form in 1789 in his *Genera Plantarum*. He particularly taken into consideration the position of the stamens with respect to the ovary and divided the plants into 15 classes. These classes were further divided into 100 natural orders (equivalent to our present day families). de Jussieu abandoned the aristotalian concept of habit and he gave emphasis on the number of cotyledons, the presence and absence of petals and the position of petals and stamens.

Augustin Pyrame de Candolle (1778-1841), a French botanist, published his views on classification in his classic work. *Theoric elementaire de la botanique,* published in 1813 in Paris. In this work he set forth the principles of a natural system of classification and further developed morphological approach to classification.

The system of de Candolle was similar to that of the Jussieu in many respects but it was certainly an improvement over that of the latter particularly in the treatment of the Dicotyledons. He divided the Dicotyledons into two groups on the basis of presence or absence of petals, the one with petals was subdivided on the basis of free or fused petals and the former was further divided on the basis of the position of ovary.

The plan of de Candolle's system is as follows :

I. Vasculares (plants with vascular bundles/cotyledons).

Class 1. Exogenae (Dicotyledoneae; vascular bundles arranged in a ring, cotyledons two).

A. Diplochlamydeae (flowers with a double whorl of perianth, calyx and corolla both present).

(a) Thalamiflorae (polypetalous and hypogynous).

(b) Calyciflorae (perigynous or epigynous).

(c) Corolliflorae (gamopetalous and hypogynous).

B. Monochlamydeae (flowers with a single whorl of perianth).

Class 2. Endogenae (Monocotyledoneae; vascular bundles scattered, cotyledon one).

A. Phanerogamae (flowers present).

B. Cryptogamae (flowers absent, hidden or unknown).

II. Cellulares (plants without vascular bundles/cotyledons).

Class 1. Foliaceae (leafy and sexual; includes mosses and liverworts).

Class 2. Aphyllae (leafless and without known sexes; algae, fungi and lichens).

One of the serious drawback of the de Candolle's system was the inclusion of vascular cryptogams among Monocotyledons.

de Candolle's monumental work was *Prodromous Systematis Naturalis Regni Vegetabilis* which was published between 1824 and 1873 wherein he has given description of every species of seed plant known to science at that time. A.P. de Candolle could not complete this work during his life time and after his death his son Alphonse de Candolle continued the work.

Q. 3. *Explain the fundamental principles adopted in Hutchinson's system of classification.*

Ans. Other things being equal, it may be stated that :

1. Evolution is both (1) upwards and (2) downwards. The latter involving degradation and degeneration, examples : (1) towards the sympetalous condition; epigyny; (2) towards the apetalous state of many flowers; unisexuality in flowering plants.

2. Evolution does not necessarily involve all organs of the plant at the same time; and one organ or set of organs may be advancing while another set

Scanned by CamScanner

is stationary or retrograding. For example in the family Crassulaceae the carpels have remained free while some genera are sympetalous.

3. Evolution has generally been consistent, and when a particular progression or retrogression has set in, it is persisted into the end of the phylum; examples the strong tendency to zygomorphy of the corolla coupled with the reduction in the number of stamens in Engler's hypogynous *Metachlamydeae* : the great tendency to perigny and epigyny in the *Archichlamydeae* and *Metachlamydeae* as exhibited in the families *Apiaceae* and *Rubiaceae* respectively.

Relating to the General Habit of Plants :

4. In certain groups, trees and shrubs are probably more primitive than herbs; examples : Mimosaceae and Caesalpiniaceae (trees and shrubs) as compared with the family Fabaceae (Papilionaceae) (becoming herbaceous).

5. Trees and shrubs are older than climbers, the latter habit having been acquired through particular environment.

6. Perennials are older than biennials, and from them annuals have been derived; note the extraordinarily few annuals in the primitive Ranunulaceae and in Rosaceae; the great number in the more advanced and natural family Brassicaceae.

7. Aquatic phanerogams are as a rule more recent than terrestrial (at any rate in the members of the same family or genus), and the same may be said of epiphytes and parasites.

Relating to the General Structure of Flowering Plants :

8. Plants with collateral vascular bundles arranged in a cylinder (Dicotyledons) are more primitive in origin than those with scattered bundles (Monocotyledons), though it does not necessarly follows that the latter have been directly derived from the former.

10. As a rule simple leaves precede compound leaves.

Relating to the Flowers and Fruits of Plants :

11. Bisexual (Hermaphrodite) precede unisexual flowers, and the dioecious is probably more recent than the monoecious condition.

12. The solitary flower is more primitive than the inflorescence, the highest forms of the latter being the umbel and capitulum; examples of the latter : Apiaceae and Asteraceae respectively.

13. Spirally imbricate floral parts are more primitive than whorled and valvate; examples : *Magnolia* ad *Clematis*.

14. Many-parted flowers (polymerous) precede, and the type with few parts (oligomerous) follows from it, being accompanied by a progressive sterilisation of reproductive parts (sporophylls); examples : *Magnolia* and *Cherianthus*.

15. Petaliferous flowers precede apetalous ones, the latter being the result of reduction.

16. Free petals (polypetaly) are more primitive than connate petals (sympetaly).

17. Actinomorphy (regularity) of the flower is an earlier type than zygomorphy (irregularity); examples ; *Caltha* and *Delphinium*.

18. Hypogyny is the primitive structure, and from it perigyny and epigyny were derived later.

19. Free carpels (apocarpy) are more primitive and from them connate carpels resulted, sometimes however, when the carpels have remained loosely united during evolution they may again become quite free, especially in fruit; example : Asclepiadaceae.

20. Many carpels (polycarpy) precede few carpels (oligocarpy) example : *Ranunculus* and *Nigella*.

21. The endospermic seed with small embryo is primitive and the non-endospermic seed more recent; examples; Ranunculaceae and Rosaceae.

22. In primitive flowers there are many stamens, in more advanced flowers few stamens; examples : *Ranunculus* and *Cherianthus*. This condition may, however, be reversed within the confined of a single family like Papaveraceae, where bees feed on the pollen.

23. Separate stamens precede connate stamens; Examples : Tiliaceae and Malvaceae, Campanulaceae and Lobeliaceae.

24. Aggregate fruits (fruits formed several separate flowers) are more recent than single fruits, and as a rule the capsule.

Q. 4. *Explain the Takhtajan's system of classification.*

Ans. Armen Takhtajan, an academician of Leningrad, Russia, presented a system of classification of angiosperms for the first time in 1942, and thereafter its revised versions in 1954, 1966, 1969 and 1980 respectively. Takhtajan's approach is quite similar to that of Cronquist. According to him the angiosperms are of monophyletic origin and evolved from some ancient group of gymosperms.

The evolutionary tendencies followed by Takhtajan are as follows :

Woody plants precede herbaceous plants.

Scanned by CamScanner

Sparingly branched trees gave rise to the trees with numerous slender branches.

Evergreen trees precede deciduous woody plants.

Simple pinnately–nerved leaves precede pinnately lobed, pinnatifid and pinnatisect leaves with pinnate venation.

Simple leaves precede compound leaves and *vice versa.*

Pinnate venation precedes palmate venation. Reticulate venation precedes parallel venation.

Alternate leaf arrangement precedes opposite and verticillaster arrangements.

Stomata with subsidiary cells are primitive and without subsidiary cells are advanced.

Tripentalacunar type of nodal structure is primitive, and unilacunar type is advanced.

The vessel members with scalariform perforations precede the vessel members with simple perforations.

Tracheids gave rise to fibre tracheids, and then to libriform fibres.

Cymose inflorescence is primitive, and racemose is derived one.

Primitive flowers are spiral whereas advanced are cyclic in arrangement of their foral organs.

The primitive stamens were leaf-like, and with marginally situated mocrosporangia.

The pollen is derived from monocoplate to tricolpate and from tricolpate to triporate. The exine of primitive pollen was without external sculpturing whereas in advanced polen there was sculpturing of various types.

Apocarpy precedes syncarpy.

Bitegmic ovules are primitive, whereas unitegmic are advanced.

Crassinucellate ovules precede tenuinucellate ovules. Antropous ovule is primitive; the other types are derived from it.

Entomophily gave rise to anemophily and *vice versa.*

Polygonum-type of embryo sac is primitive, the other types are derived from it.

Endospermic seeds are primitive, whereas non-endospermic seeds are advanced. The monocot embryo is evolved from dicot embryo.

Many seeded follicle is most primitive type of fruit, from this other types are evolved.

Takhtajan has divided his Division–Magnoliophyta (= Angiospermae) into two classes–Magnoliopsida (= Dicotyledones) and Liliopsida (= Monocotyledones). He has further divided–Class Magnoliopsida into seven sub-classes and twenty superorders, and Liliopsida into three sub-classes and eight superorders.

According to him the order Magnoliales is most primitive among the flowering plants. All other angiosperms have been derived from the Magnoliales.

The order Alismatales has been susposed to be most primitive among monocotyledons and the members of the other monocotyledonous orders have been derived from them.

According to him the highest evolved order among dicotyledons is Asterales; and Arales among monocotyledons.

The outline of Takhtajan's (1980) system is as follows :

Division Magnoliophyta (= Angiospermae)

Class A. Magnoliopsida (= Dicotyledons)

Sub-class I	Magnoliidae
Superorder	I. Magnolianae
Order	1. Magnoliales (Annonales)
" "	2. Illiciales
" "	3. Laurales
" "	4. Piperales
" "	5. Aristolochiales
Superorder II.	Rafflesianae
Order	6. Rafflesiales
Superorder III.	Nymphaenae
Order	7. Nympheales
" "	8. Nelumbonales
Sub-class B.	Ranunculidae
Superorder IV.	Ranunculanae
Order	9. Ranunculales
" "	10. Papaverales
" "	11. Sarraceiniales
Sub-class C.	Hamamelididae
Superorder V.	Hamamelidanae

Scanned by CamScanner

Order	12. Trochodendrales
" "	13. Cercidiphyllales
" "	14. Eupteleales
" "	15. Didymelales
" "	16. Hamamelidales
" "	17. Eucommiales
" "	18. Urticales
" "	19. Barbeyales
" "	20. Casuarinales
" "	21. Fagales
" "	22. Balanopales
" "	23. Leitneriales
Superorder VI.	Juglandanae
Order	24. Myricales
" "	25. Juglandanles
Sub-class D.	Caryophyllidae
Super order VII.	Caryophyllanae
Order	26. Caryophyllales
" "	27. Polygonales
Super order VIII.	Plumbaginanae
Order	28. Plumbaginales
Sub-class E.	Dilleniidae
Order	29. Dilleniales
" "	30. Paeoniales
" "	31. Theales
" "	32. Violales
" "	33. Bigoniales (Datiscales)
" "	34. Capparales
" "	35. Tamaricales
" "	36. Salicales
Superorder X.	Ericanae
" "	37. Ericales
" "	38. Ebenales
" "	39. Primulales
Superorder XI.	Malvanae
Order	40. Malvales

" "	41. Euphorbiales
Sub-Class F.	Rosidae
Superorder XII.	Rosanae
Order	42. Saxifragales
" "	43. Rosales
" "	44. Fabales
" "	45. Connarales
" "	46. Podostemales
" "	47. Nepenthales
Superorder XIII.	Myrtanae
Order	48. Myrtales
Superorder XIV.	Rutanae
Order	49. Rutales
" "	50. Sapindales (Acerales)
" "	51. Geraniales
" "	52. Polygalales
Superorder XV.	Aralianae
Order	53. Cornales
" "	54. Araliales (Apiales)
Superorder XVI.	Celastranae
Order	55. Celastrales
" "	56. Santalales
" "	57. Balanophorales
" "	58. Rhamnales
" "	59. Elacagnales
Superorder XVII.	Proteanae
" "	60. Proteales
Sub-class G.	Asteriadae
Supeorder XVIII.	Gentiananae
Order	61. Gentianales
" "	62. Oleales
" "	63. Dipsacales
" "	64. Loasales
Superorder XIV.	Lamianae
" "	65. Polemoniales

Scanned by CamScanner

" "	66. Lamiales
" "	67. Scrophulariales
Superorder XX.	Asteranae
" "	68. Campanulales (including Goodeniales)
" "	69. Calcyceralesz
" "	70. Asterales

Class-Liliopsida (= Monocotyledones)

Sub-class A.	Alismatidae
Superorder I.	Alismatanae
Order	1. Alismatales
" "	2. Najadales (including Aponogetonales, Potomogetonales and Zosterales)
Sub-class B.	Lilidae (including Commelinidae and Zingiberidae)
Superorder II.	Triuridanae
Order	3. Triuridales
Superorder III.	Lilianae
" "	4. Liliales
" "	5. Smilacales
Order	6. Burmanniales
" "	7. Orchidales
" "	8. Bromeliales
Superorder IV.	Junacanae
Order	9. Juncales
" "	10. Cyperales
Superorder V.	Commenlinanae
Order	11. Commelinales
" "	12. Eriocaulales
" "	13. Restionales
" "	14. Hydatellales
" "	15. Poales
Superorder VI.	Zingiberanae
Order	16. Zingiberales.

Sub-class C.	Arecidae
Superorder VII.	Arecidae
Superorder VII.	Arecanae
Order	17. Arecales
" "	18. Cyclanthales
" "	19. Pandanales
" "	20. Typhales

Q. 5. ***Describe the Phylogenetic system of classification with merits and Demerits.***

Ans. Phylogenetic System : This is based on phylogenetic relationship of plants bearing on the concepts of evolution. The systems of classification proposed by Engler, a German botanist, in 1886, by Hutchinson, an English botanidst, in 1926 and by Tippo, an American botanist. In 1942 are phylogenetic.

Engler's System. Engler's system is based on Eichler's system (1883), the major categories of that system having been accepted by Engler and his associates. Adolf Engler (1844-1930), Professor of Botany at the University of Berlin, first proposed his system in 1886 s a guide to the botanical garden at Breslau. The system was published in an expanded and elaborated form in *Die Naturlichen Pflanzenfamilien* (1887-1909) in 23 volumes covering the whole range of the plant kingdom, under the editorship of Engler and Prantl. Engler and Gilg's *Syllabus der Pflanzenfamilien* published in 1892 gives a comprehensive idea about the systematic classification of 'flowering' plants and cryptogams and is a very useful publication. According to Engler's system the plant kingdom has been divided into 13 divisions, of which the seed-bearing plants (Spermatophyta) form the last division named 'Embryophyta Siphonogama'. This has been further divided into two sub-divisions—(1) Gymnospermae and (2) Angiospermae; the latter further divided into two classes—(a) Monocotyledoneae and (b) Dicotyledoneae. Monocotyledoneae has been directly ivided into 11 orders with 45 families, while Dicotyledoneae into two sub-classes—(i) **Archichlamydeae** containing 30 orders with 190 families representing the lower dicotyledons and (ii) **Sympetalae** (or Metachlamydeae) containing 10 orders with 53 families representing the higher icotyledons. The orders have been further subdivided into sub-orders, families and genera. There are altogether 288 families. Monocotyledoneae begins with *Typhaceae* and ends in *Orchidaceae*, while Dicotyledoneae begins with *Casuarinaceae* and ends in *Compositae*.

Scanned by CamScanner

The principle involved in this system of classification is tracing the increasing complexity of flowers, particularly their accessor whorls, viz., achlamydeous flowers (no perianth), haplochlamydeous flowers (one whorl of perianth) and diplochlamydeous flowers (two whorls of perianth). Those with no perianth or with only one whorl or with polypetalous corolla form the sub class **Archichlamydeae**; gamopetalous condition with 1 or 2 whorls of perianth comes under the sub-class **Sympetalae**. The latter represents more advanced groups of dicotyledons. Within the sub-class progress is indicated through hypogyny, perigyny and epigyny, and from a variable number of stamens and carpels to a definite number. Among dicotyledons Engler starts with the family *Casuarinaceae* on the assumption that woody polants with unisexual apetalous flowers borne in catkins are the most primitive.

Mertis : (1) Classification of the whole plant kingdom with necessary sketches, records of numbers of species and keys for identification of all known genera of plants. (2) A natural system based on relatioinship and compatible with evolutionary principles. (3) A sytem where groups have been built up step by step to form a generally progressional morphological series. (4) Phylogenetic arrangement of many groups. (5) Abolition of Apetalae (Monochlamydee) considering it an artificial group and amalgamation of Polypetalae and **Apetalae** into a new group, i.e., sub-class Archichlamydeae. (6) *Compositae* and *Orchidaceae* are considered, very reasonably, the highest families of dicotyledons and monocotyledons respectively in vierw of their most highly evolved characters. Because of its merits Engler's system was accepted by American and British botanists.

Demerits. (1) Precedence of monocotyledons over dicotyldeons. Higher dicotyledons and the monocotyledons are believed to have developed from some primitive dicotyledonous stock. (2) *Casuarinaceae* is considered most primitive among dicotyledons and placed at the beginning of his system; this view is no longer acceptable. (3) Amentiferae, i.e., the catkin-bearing families with unisexual flowers, e.g., *Fagaceae*, *Salicaceae*, *Betulaceae*, etc., are considered primitive among dicotyledons and placed early in his system. This group is now considered as advanced rather than primitive. Ranales like *Ranunculaceae*, *Nymphaeaceae*, etc. can never be derived from them. The primitive nature of Ranalean families is now almost universally accepted by the taxonomists. Centrospermae, e.g., *Amarantaceae*, *Caryophyllaceae*, etc., can not precede Ranales,. (4) Derivative of dicotyledons from gymnosperms with unisexual strobili. (5) The system as a whole can not be regarded as phylogenetic. (6) Position of Helobiae, e.g., *Potamogetonaceae*, *Alismaceae Hydrocharitaceae*, etc., between Pandanales and Glumiflorae is very unsatisfactory; both Pandanales and Glumiflorae are advanced groups. (7) Similarly, *Araceae, Lemnaceae* and *Typhaceae* are supposed to be derived flom *Lilaceae* and therefore can not precede it.

Q. 6. *What is Taxonomy ? Explain the unit of Classification.*

Ans. Systematic Botany or Taxonomy : This deals with the description, identification and naming of plants, and their classification into different groups according to their resemblances and differences, mainly in their morphological characteristics. So far as angiosperms or higher 'flowering' plants are concerned, it has been estimated that over 199,000 species (dicotyledons—159,000 and monocotyldeons—40,000) are already known to us, and that many thousands more have yet to be discovered and recorded. Thus plants are not only numerous but are of varied types and it is not possible to study them unless they are arranged in some orderly system. The object of systematic botany or taxonomy is to describe, name and classify plants in such a manner that their relationship with regard to their descent from a common ancestry may be brought out. The ultimate object of classification is to arrange plants in such a way as to give us idea about their phylogenetic relationships, i.e., the squence of their origin and evolution from simpler, earlier and more primitive types to more complex, more recent and more advanced types in different periods of the earth. The earlier classifications of plants were based on their economic uses, e.g., cereals, medicinal plants, fibre yielding plants, oil-yielding plants, etc., or on gross structural resemblances, e.g., herbs, shrubs, trees, climbers, etc. These classifications were incomplete and fragementary as plants that did not fit into such classifications or were of no economic value were usually ignored. An ideal system of classification should, therefore, not only indicate the actual genetic relationship but should also be within a reasonable limit of convenience for practical purposes.

Units of Classification

Species : A species is a group of individuals (plants or anomaks) having a very close resemblance with one another structurally and functionally. The individuals of a species interbreed in nature freely and successfully among themselves so that they may be taken as having descended from the same parent stock, and they also breed true to type, i.e., give rise to the progeny of the same kind. They have also normally the same number of chromosomes in their cells—$2n$ in somatic cells and n in reporductive cells. Thus all pea plants to-

Scanned by CamScanner

gether constitute a species. Similarly all banyan plants, all peepul plants and all mango plants constitute different and distinct species. Species, however, often show a wide range of variations, with many intermediate forms or gradations, serving as connecting links between two allied species. It has, therefore, not been possible to draw a line of demarcation between one species and another allied one, nor to delimit the boundary of any one particular species. This being so, it becomes very difficult to give an accurate and rigid definition of a species and thus taxonomists have often differed regarding the latitude of a species. Nevertheless, the importance of species, however vaguely and arbitrarily defined, as fundamental units of classification, has never been ignored by the taxonomists. It will further be noted that all the characteristics of a species are attributable to the behaviour of DNA in the chromosomes. DNA carries the same genetic code from generation to generation, controls the development of the same set of parental characteristics in the offspring and thus normally limits the bondary of a species.

Sometimes under the influence of external conditions certain individuals of a species may show a marked degree of variation in form, size, shape, colour and other minor characteristics. Such plants are said to form **varieties**. A species may consists of one or more varieties or none at all. We have thus different varieties of common garden pea, rice, potato, mango, etc. Varieties, however, are not permanent. They tend to revert to the original species from which they were derived.

Genus : A genus is a collection of species which bear a close resemblance to one another in the morphological characters of the floral or reproductive parts. For example, banyan, peepul and fig are different species because they differ from one another in their vegetative characters such as the habit of the plant, the shape, size and surface of the leaf, etc. But these three species are allied because they resemble one another in their reproductive organs, namely, inflorescence, flower, fruit and seed. Therefore, banyan, peepul and fig come under the same genus and that is *Ficus*.

Nomenclature : A plant name has to parts. The first refers to the genus and the second to the species. This system of designating every type of plant with a *ibinomial*, i.e., a name consisting of two parts, is known as binomial nomeclature, and was first established by Linnaeus and finally settled by the International Botanical Congress held at Amsterdam in 1935. Thus pea has received the name of *pisum sativum*, rice *Oryza sativa*, mango *Magifera indica*, banyan *Ficus bengalensis*, peepul *Ficus religiosa*, fig *Ficus carica* and

india-rubber plant *Ficus elastica*. Referring to cottons, we find that they all belong to the same genus *Gossypium* which consists of about 20 or more species such as BANI cotton of India (*Gossypium indicum*), KUMPTA cotton of the southern Maratha country (*G. herbaceum*), American cotton (*G. barbadense*), KIL cotton of Assam (*G. cernuum*), BURI cotton—the upland American cotton naturalized in India (*G. hirsutum*) and so on. The name of the author who first described a species is also written in an abbreviated form the name of the species, e.g., *Mangifera indica* Linn. Here Linn refers to the author 'Linne' or 'Linnaeus' who first described the plant.

Family : A family is a group of genera which show general structural resemblances to one anther mainly in their floral organs. Thus in the genera *Gossypium, Hibiscus, Thespesia, Sida, Abutilon, Malva*, etc., we find free lateral stipules, epicalyx, twisted aestivation of corolla, monadelphous stamens, unilocular anthers, axile placentation, etc. So all the above-mentioned genera belong to the same family and that is *Malvaceae.*

Q. 7. *Describe the systems of Classification.*

Ans. Ssytems of classification may be artificial, natural or phylogenetic. Ssytems have developed in a stepwise manner from the earliest to the present times and four periods depending on criteria used in classification may be recognized. *Ist period* : this extends over several centuries from about 300 B.C. to the end of ther 17th century; during this period systems werre based on the **habit** of plants, *2nd period* : this extends from the thirties to the end of the 18th century; this period records a definite change in the pattern of systems; the habit has given place to **sex organs** (stamens and carpels) of plants and Linnaeus sexual system of classification (1735) is specially remarkable. *3rd period* : this extends from the beginning to the eighties of the 19th century; there are several famous botanists of this period; systems propounded during this period have been based on **natural relationships** of forms; Bentham and Hooker's natural system of classification (1862-83) is of outstanding merit. *4th period* : this period extends from 1875 (possibly 1883) to the present times; system of this period have been based on **phylogenetic relationships** of plants.

Artificial System. In the artificial system only one or at most a few characters are selected arbitrarily and plants are arranged into groups according to such characters; as a result closely releated plants are often placed in different groups, while unrelated plants are often placed in the same group because of the presence or absence of a particular character. This system enables us to determine readily the names of plants but does not indicate the natural rela-

Scanned by CamScanner

tionship that exists among the individuals forming a group. It may thus be compared to the manner of arrangement of words in a dictionary in which, except for the alphabetical order, adjacent words have no necessary agreements with one another. Thus the defect in the artificial system of classification is that plants resembling one another closely, instead of being grouped together, become widely separated. Nevertheless, the artificial system is of very great advantage in view of the fact th at by following this system of classification one cane without much difficulty get to the name of an unknown plant; or in other words, the identification of an unknown plant is rendered much easier by this system.

Linnaean System (1735). The best-known artificial system is that promulgated by Linnaeus (1707-78) and published by him in the year 1735, further revised in his *Genera Plantarum* (1737) and *Species Plantarum* (1753). By 1760 his system became popular in Holland and Germany and partly in England. Linnaeus classified plants according to the characters of reproductive organs, viz. stamens and carpels. Since these are regarded as the sexual organs of plants, this artificial system of Linnaeus is commonly called the 'Sexual System'. Acording to this system plants are mainly divided into 24 classes including 23 of phanerogams and one of cryptogams. Phanerogams were further subdivided into groups with unisexual or bisexual flowers. Plants with unisexual flowers were again divided according to whether they were monoecious or dioecious. Further classification was based on the number of stamens. Plants with bisexual flowers were classified according to whether the stamens were classified according to whether the stamens were united with the carpels, or were free from them. The next consideration was whether the stamens were free or united. Then the number of stamens, their length and ultimately the number of carpels were taken into account.

Natural System. In the natural system all the important characters are taken into consideration and plants are classified according to their related characters. Thus, according to their resemblances and differences, mostly in their important morphological characters, plants are first classified into a few big groups. These are further divided and subdivided into smaller and smaller groups until the smallest division is reached and that is a species. All modern systems of classification are natural and supersede the artificial ones by the fact that on the one hand they give us a true idea of the natural relationship existing between different plants based on a detailed description of characters and also of the sequence of their evolution from simpler to more complex

types in different periods of the earth, and on the other they meet, like the artificial system, the practical need of identification of unknown plants. Plants as arranged or grouped together according to these systems are further seen to possess in most cases the same or identical properties.

According to the natural system the plant kingdom has been divided into two *divisions*, viz. **cryptogams** or 'flowerless' plants (see part V) and **phanerogams** or 'flowering' plants. Phanerogames have again been divided into two *sub-division*, viz. **gymnosperms** or naked-seeded plants (see part VI) and **angiosperms** or closed-speded plants. Angiosperms have further been divided into two *classes*, viz. **dicotyledons** and **monocotyledons**. The classes have been divided into *ordrs*; the orders into *families*; families again into *genera* and genera into *species*; and sometimes species into *varieties*. If a greater number of intermediate categories are required, the prefix *sub* is added to the particular term.

Bentham and Hooker's System (1862-83). Bentham (1800-84) and Hooker (1817-1911), two English botanists, contemporaries of Darwin, elaborated a natural system of classification of 'flowering' plants (dicotyledons, gymnosperms and monocotyledons) giving more or less equal status to all the three groups. Their system is based on (virtually an extension of) de Jussieu's system (1789) and de Candolle's system (1819). Their system was published in *Genera Plantarum* in which they discussed dicotyledons first, then gymnosperms and finally monocotyledons. They divided dicotyledons into 3 subclasses and 14 series; series into cohors (equivalent to orders) and cohorts into orders (equivalent to families). There are altogether 202 orders of angiosperms—165 orders of dicotyledons and 37 orders of monocotyledons. They started with the family *Ranunculaceae* (with polypetalous corolla and indefinite number of free stamens and carpels) and ended in *Labiatae* (with gamopetalous corolla and a definite number of stamens and carpels), leaving out Incompletae and an anomalous series. They divided monocotyledons into 7 series, series directly into orders and started with orders having epigynous flowers, e.g., *Orchidaceae* and *Scitaminae*, passed through orders with petaloid hypogynous flowers, e.g., *Liliaceae*, and then through orders with flowers which have lost their petaloid character, e.g., *Palmae* and *Araceae* and finally to *Gramineae* and *Cyperaceae* with simple construction of flowers and presence of glumes. An outline of this system of classification is as follows.

Scanned by CamScanner